ISSN 1733-8670

ZESZYTY NAUKOWE NR 9(81)
AKADEMII MORSKIEJ
W SZCZECINIE

INLAND SHIPPING 2005

Iouri Semenov

Innovative Conceptions Impacts on Development System of Inland Navigation Network

Key words: inland navigation networks, innovative conception, linear shipping, tramp shipping, river port, intermodal, multi-trailer system, "multi-points" mode

Inland navigation is the oldest mode of cargo and passenger traffic, counting nearly 5000 years. Now this transport mode gets the main importance again, which requires innovative changes in the inland waterway networks, vessels and its service systems. This is due to the fact that combined rail/road transport widely used in XX century is currently struggling with high external costs along the main traffic corridors of the Trans-European Transport Network, including costs of environment renewal, congestion consequences and refund of traffic accidents charges. Experience of some EU countries has shown that innovative approaches to the organization of inland navigation as element of integrated transport systems could help to solve these problems.

Koncepcje innowacyjne rozwoju systemów transportowych z wykorzystaniem wodnych dróg śródlądowych

Słowa kluczowe: sieci transportu śródlądowego, koncepcja innowacyjna, żegluga regularna, żegluga trampowa, port rzeczny, intermodalność

Żegluga śródlądowa jest najstarszym rodzajem przewozów towarowych i pasażerskich i liczy około 5000 lat. W obecnych czasach ta gałąź transportu ponownie nabiera znaczenia, co wymaga zmian organizacyjnych oraz podwyższenia skuteczności systemów obsługiwania. Wygania te związane są z pewnymi zmianami koncepcyjnymi. Wynika to z faktu, że transport kombinowany kolejowo-drogowy szeroko stosowany w XX wieku coraz częściej zmaga się z wysokimi kosztami zewnętrznymi obejmującymi koszty odnawiania środowiska, koszty kongestii oraz koszty związane z poważnymi skutkami wypadków samochodowych. Doświadczenie krajów UE pokazuje, że innowacyjne podejście do organizacji transportu śródlądowego jako podstawowego ogniwa zintegrowanych systemów transportowych może pomóc rozwiązać te problemy.

Introduction

The basic purposes of Poland's transport development are creation of favorable conditions for fuller and effective satisfaction of the region's economic needs and the country as a whole in sustainable transport services, expansion of intra-EU transportation, competitiveness increase of Polish commodity producers and carriers in the world transport markets, and also of population mobility, with simultaneous reduction of traffic congestion on roads, railways etc. and decrease of environmental impacts. One direction for the achievement of these purposes is the development inland shipping networks on the basis of innovative traffic technologies that answer the directions of EU transport policy:

- to make better integration of Poland's inland shipping into the common European transport system;
- to create favourable conditions for the development of inland shipping;
- to encourage business to widen the use of inland navigation;
- to format conditions for quality services of passengers with disabilities;
- to coordinate the development of Poland's transport infrastructure with the purpose of fuller integration with EU logistical systems for wide unobstructed transportation;
- to optimize the transport process with the purpose of transportation quality improvement and decrease transport expenses in the final cost of the goods;
- to create conditions for tariffs decrease by means of the transportation capacity increase of Poland's transport;
- to localize effectively the intermodal logistical terminals;
- to increase investment project funds for quick development of a transport infrastructure network and the best use of available resources;
- to reduce truck traffic, which means meeting the EU requirements to increase waterways transportation (towing) and providing convenient connections into landside/waterside networks intra- EU and outside- EU;
- to create conditions for promoting increase of service quality (information, safety, accesses).

If problems of congestion and pollution are obvious it is necessary to search for other ways of the freight/passengers transportation guaranteeing higher carrying capacity and environment friendliness, namely, a railway, short-sea shipping, inland navigation. The European Union has for some time recognized the great potential that Europe's inland waterway network has for freight and passenger transport. Inland waterway transport is considered fairly cheap and efficient, reliable, safe and environment friendly, particularly compared with road transport.

Basic tasks and trends

Limitation of resources on development of inland waterway transport demands their concentration on the major directions accordance with Poland's national interests. In this connection, based on the analysis of modern experience, the following are of dominant importance for inland navigation development:

- R&D on the segment market of inland navigation, with the purpose of: preservation of traditional waterway cargo-carrying and development of new inland waterway routes;
- construction of innovative vessels for short-route consignment delivery for freight/passengers service on the small rivers, e.g. small-draft vessels;
- modernization of passenger vessels according to the requirement of comfortable conditions;
- development of a coastal and riverside infrastructure for service passengers;
- widening of the material base of waterborne transport education;
- modernization of shipbuilding and repair yards,
- enlargement, reconstruction and modernization of inland ports (see Table 1).

Making a decision about the indicated problems will allow using effectively inland waterway transport to lower transport expenses, to improve an ecological situation, to provide safety of traffics and to increase the number of workplaces. Inland navigation using super-size tugboat/barges systems, also as novel self-propelled vessels can have great future. Depending on freight traffic capacity, tugboat/barges systems can be using "point-to-point" (linear shipping) or "multi-points" (tramp shipping) schemes that are defined by transportation profitability. In rivers with limited fairway sizes, expedient tugboat/barges systems equip an articulate architecture, more effective in comparison with self-propelled ships. The role of inland waterway transport in the common EU transport system will be defined by competitiveness and innovative forms of servicing. In this situation the main goals of EU transport policy are: the organization of a stable and high-quality service of cargo flows; the improvement of interoperational multimodal systems; consignors free from superfluous transport risk; preparation of conditions for an innovative conceptions implantation, e.g. intermodal cargo-carrying according to the "Trunk &feeder" scheme.

Inference 1. Elements of the transport potential of inland navigation are:

- the development of inland waterway systems for safe navigation;
- the accessibility of inland ports` infrastructure for cargo/passengers flows;
- the level of the transport services (must be satisfactory for passengers);
- transportation time and tariffs (must be satisfactory for consignors);
- the compatibility with worldwide logistic chains.

In future transport development it is possible that 30 – 40% of the cargo's volume will be transferred from roads to inland waterways.

Table 1

Inland ports characteristics
Charakterystyka portów śródlądowych

Ports classes	Ports zones	Port's infrastructure		
		Wharfs	Equipment	
Interregional	Passenger's departure /arrival area	– 4 – 6 wharfs for passenger vessels – 2 – 4 wharfs for recreation boats ΣL= 800-1000 m	A modern terminal building with: – service facilities, e.g. restaurants, hotel, waiting rooms, ticket office, etc. – port facility security, e.g. personal protection system, policies, surveillance	The port's railway station available, with spur tracks and access roads. Facilities for complex servicing of the fleet.
	Container's dispatching area	– 3–5 container wharfs – 2 – 4 wharfs for RO-RO freight – 1 – 2 wharfs for heavy weights ΣL= 800-1200 m	Open warehouses: S= 5000-150000 sq. m. with 500- 1500 sockets for refrigerated containers Cranes: portal 5-12; floating - 3 -5; others - 5-15 units Straddle carriers, platform scales etc.	
	Dry-bulk dispatching area	– 10 – 30 wharfs Trans-shipment of coal, gravel, grain etc. – 2 – 4 wharfs reloading grain ΣL= 1000–3000 m	Warehouses: open S=150 000 – 800 000 sq. m. closed S=20000-100000 sq. m. Cranes: portal 8-30; floating - 5 -25; others - 10-40 units Straddle carriers, forklifts, platform scales, suppressor- pilers, clam-type suppressors, piping, platform scales	
	Liquid bulk dispatching area	– 3-10 wharf reloading of crude oil and oil products ΣL=500 – 1700 m	Inflammable stores: closed V= 250000- 500000 t Pipelines, oil-line pumps, field pumps Safety system, incl. monitoring system, electronic surveillance, fire fighting equipment etc.	
Regional	Passenger's departure /arrival area	– 1-2 wharfs for passenger ferry – 1-2 wharfs for recreation boats ΣL=150 – 300 m	A terminal building with: – services facilities, e.g. waiting room, ticket office and café – port facility security, e.g. personal protection system, fences, electronic surveillance, policies, etc.	Intra-port networks for connection e.g. with railway station
	Container's dispatching area	– 1-2 container wharfs – 1-2 RO-RO wharfs ΣL=250 – 450 m	Open warehouses: S=2000-300000 sq. m with 200- 400 sockets, platform scales, Cranes: portal - 2-4; others - 2-4 units	
	Dry-bulk dispatching area	– 3-7 wharfs Trans-shipment of coal, gravel, grain etc. ΣL=600-1400 m	Warehouses: open S=100000 – 600000 sq. m. closed S=10000-70000 sq. m. Cranes: portal - 3-10; others - 5-7 units	
Local	Passenger's area	– 1-2 wharfs for passenger vessels L= 50 - 100 meters	Wharf-boat, mooring equipment, ticket office, monitoring system café	Road

Source: Author's research based on: Robinson A., *Inland Ports & Supply Chain Management.* IBA, Conf.: Global Perspectives, Mexico, 1999; South East, London & East of England Regional Ports Strategy. Shipping Sector Review, Local Authority Group, London, 2001.

Management of the inland waterway transportation

Any enterprise including enterprise-carriers has three interconnected purposes of management:

1. to provide qualitative service for passengers and consignors;
2. to implement effective financial policy;
3. to increase competitiveness using marketing methods.

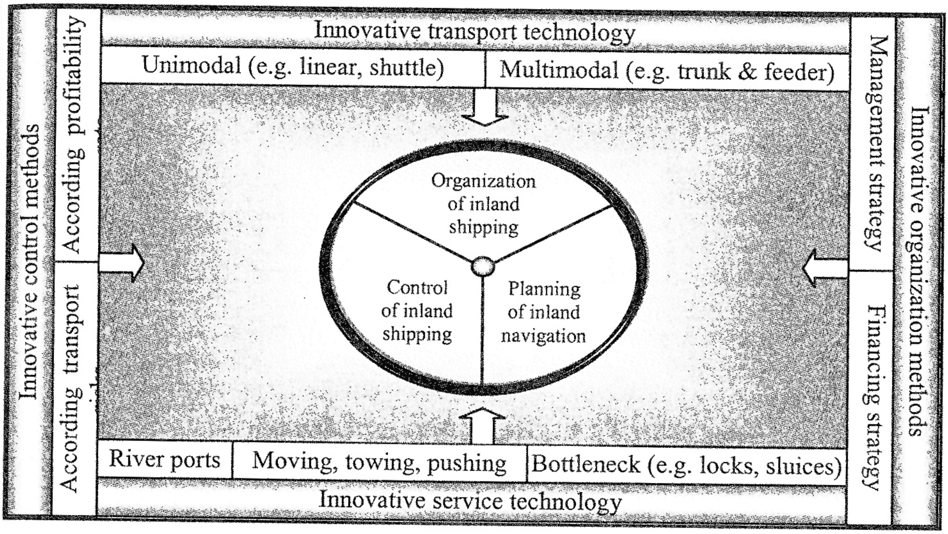


Fig.1. Components of the inland navigation management
Rys.1. Składowe zarządzania transportem śródlądowym

Achievement of these purposes is possible thanks to rational planning, organization and transportation control (shown in Fig.1).

The characteristics of inland transport process

The general purpose of Inland Shipping Networks is cargo and passengers transportation, and its elements:

- Rivers and coastal ports (logistical centers) are intended for cargo receipt from consignors (including wharfs, cranes, warehouses).
- Inshore terminals are intended for cargo receipt from any vessels.
- Entrance locks are intended for lockage of vessels on canals.
- Sluices are intended for sluicing a vessel on rivers.
- Fairways are intended for freight/passengers service under hauling from a PoO (Port of Origin) to a PoD (Port of Destination).

For the requirement of estimating the vessel's cargo-carrying capacity (NT-netto tonnage & DWT-deadweight tonnage) a graphic procedure can be recommended. Let's investigate two tasks.

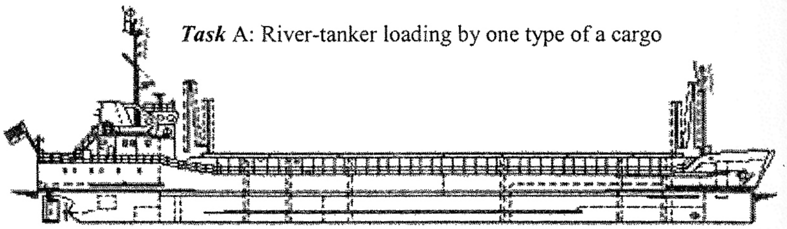
Task A. Vessel used under "point-to-point" mode i.e. linear shipping. Here the vessel is loaded with one type of cargo (Illustration in Table 2).

Table 2

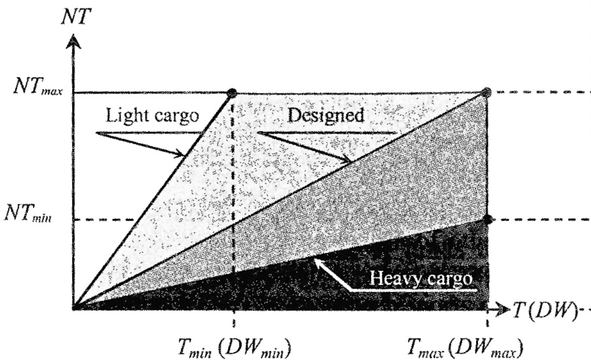
Task A. Graphic interpretation

Ilustracja graficzna zadania A

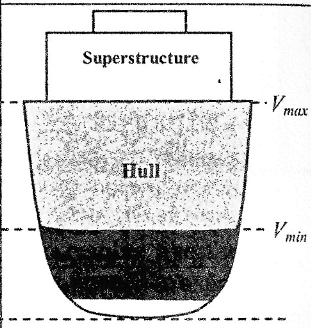
Task A: River-tanker loading by one type of a cargo



NT changes vs. changes of the river-tanker's draught



The river-tanker tonnage



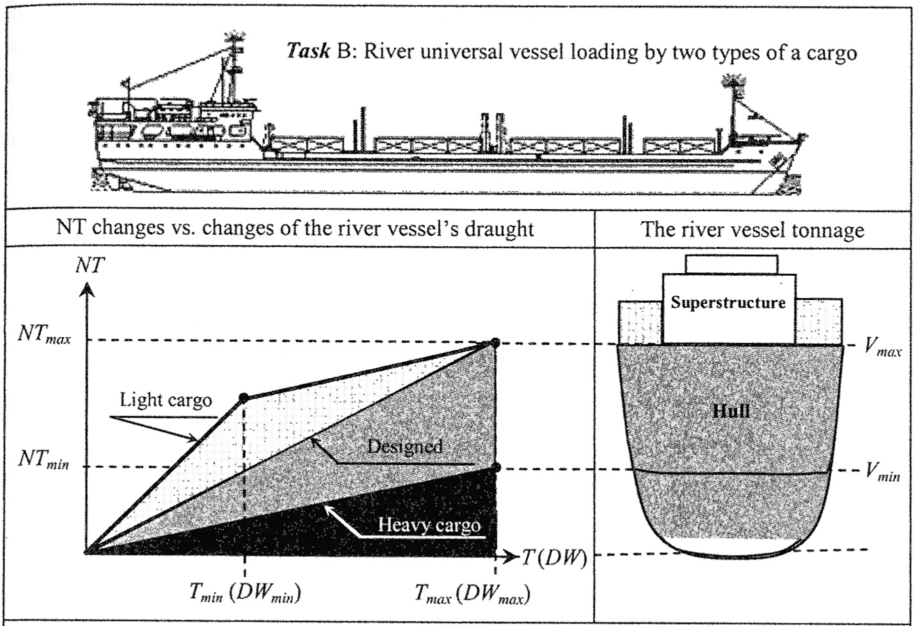
Source: Author's research

The analysis allows suggesting the following opinion; that the vessel is rationally used probably only in the case of the designed cargo's transportation. From practice, such situations don't exceed 0.3 – 0.4 likelihood in traffic using inland waterways navigation. In this case the condition of river vessels profitability requires stable freight flows, and can be used under the shuttle-type transportation scheme.

Task B. Vessel used under "multi-points" mode i.e. tramp shipping. Here the vessel is loaded with two types of cargo. Suppose we are required to load light freight and heavy freight. (Illustration in Table 3).

Table 3

Task B. Graphic interpretation
Ilustracja graficzna zadania B



Source: Author's research

The analysis allows suggesting the following opinion: the linear shipping has lower functional efficiency than tramp shipping under the following conditions, namely small partial shipments or short consignment delivery. Thus there is a basis to assert that the inclusion of inland navigation in intermodal networks will allow raising its functional efficiency, especially in conditions of unstable cargo flows. Therefore, river-vessels are profitable if they are included into transport networks according to the "Trunk & feeder" scheme. The further increase of river navigation's efficiency depends on feeder transport throughput which requires wide implantation of new solutions, e.g.:

- MTS (Multi-Trailer System) as Long Train, Short Train;
- Conveyor-belt system that can eliminate up to 120,000 truck trips per year.

Inference 2. The competitiveness, vessels tonnage, terminals productivity and waterways throughput, possible environmental impacts, traffic safety and external costs have to be taken into account to compare transport schemes used. The decisive criteria for the selection of effective means of transportation are minimal transportation risk, maximal operating speed, maximal carrying ability under minimal services price.

Routing for inland navigation's tasks

The inland navigation schemes can be defined as combination of the direct and return traffic routes of freight/passengers flows. The greatest inland navigation effectiveness can be achieved if empty trips will be minimized and the mutual combination of different types of vehicles used under feeder's schemes will enhance the full use of their carrying capacity, speeds, etc. As an illustration of effectiveness criteria several functions can be offered, namely "*A minimum of the operating expense (OPEX) at the time of the circular routes*"; "*A minimum of the empty trips inside the intermodal chains*"; "*A maximum of the vehicles carrying capacity*".

Multi-ways inland navigation

Throughput of the inland navigation can be estimated by two methods, namely graphically and analytically. The graphic approach is based on the following technique:

- to each route there must be a parallel route;
- throughput estimation can be put in the practice according to the parameters "*the circle's shipping route period*" and "*the time-table period*"

The circle's shipping route period depends on operational speed of the vessel (tugboat/barges system), distances between ports and loading/unloading time at the each port. Traffic simulation allows asserting that the use of multi-ways regime in inland navigation has great throughput and can be used as solution in transport networks differing with respect to high level of congestions, traffic jams etc.

One-way inland navigation

For estimation of the time-table period under conditions of one-way traffic, the time must be defined when this route will be occupied servicing other vessels or tug/barges systems.

As regards one-way regime this has lower throughputs than multi-way regime. It's an evident statement. There are some recommendations as to how to increase it. For example, it is possible to increase the throughput increase owing to the fact that the vessels or tug/barges systems will move according to serial operation mode. The unilateral passing of the vessels (tugboat/barges systems) in comparison with bilateral passing of the vessels (tugboat/barges systems) essentially reduces to throughput of the inland waterway system. In this connection it is recommended to use the bilateral regime for the vessels (tugboat/barges systems) passing.

Organization rules of inland navigation

Dispatch interval is usually not measured by the days as whole items. Fractional value of the dispatch interval complicates the problem of the vessels` movement coordination on the one hand; on the other hand, there takes place the compatibility violation of the vehicles and the ports, tug and tonnage etc. To eliminate these negative phenomena, the numerical assessment of the dispatch interval is usually approximated to the nearest integer. It enables to coordinate dispatch time and arrival time of the vessels (tugboat / barges systems) into destination river ports. Let's introduce several rules for the purpose of successful organization of inland navigation.

Rule 1. In a situation when the dispatch interval is less than day for fruitful organization of the inland navigation formation, two and more freight traffic lines are necessary under the condition that between all departures there will be an appropriate interval.

Rule 2. In a situation when the dispatch interval is equal to fractional number exceeding one day:

- first of all, evaluate interval duration, afterwards equate the interval to the nearest smaller number of the days as whole items;
- secondly, assess an interval between the vessel's departure, afterwards increase the interval to the nearest integer;
- thirdly, pick out one form of movement organization out of two possible i.e. linear shipping ("point-to-point") or tramp shipping ("multi-point").

Conclusion

1. At present, the implantation of intermodal transport conception is the most important goal of the EU on the transport services market. Nevertheless, not more than 10% of all exchanged cargo that flows in European regions are practically transported by intermodal scheme.
2. Management and transportation organization must be improved (e.g. new approaches to consignors satisfaction, network quality management and introduction of risk-managing methods).
3. In a world of linear transport innovation, future transport demand can be forecast in terms of structurally stable relationships between factors like growth rates, elasticity and subsequently market shares of transport technologies based on expert assessment of their potential relative to competitors, suppliers, etc.
4. The economic efficiency, capacity reserves of the ships, terminals and waterways, environmental impacts, traffic safety and external costs have to be taken into account to compare transport schemes used. The decisive parameters for the selection of the means of transportation are competitiveness, availability, safety, reliability, speed and price.

References

1. Blaauw H., Wirdum M., *Increasing the competitive edge of inland waterway transport. European Inland Waterway Navigation,* Conference 11-13 June, 2003, Gyor, Hungary.
2. Brian A., Lane D., *The Economy as an Evolution Complex System*, Addison – Wesley, California Redwood City 1998.
3. Economides N., Flyer F., *Compatibility and Market Structure for Network Goods.* New-York University Press, New-York, November 1997.
4. *European Inland Waterway Network Mores Forward.* UN/ECE News. Press Release, Geneva, ECE/TRANS/00/3 14 April 2000.
5. Final Report: *Environmental Advantages of Inland Barge Transportation*, U.S. Department of Transportation, Maritime Administration Press, 09.1994
6. Levinthal D., Muatt J., *Evolution of Capabilities and Industry: The Evolution of Mutual Fund Processing*, Strategic Management Journal, vol. 15, pp.45-62 December 1994.
7. *Multimodal transport: The feasibility of an international legal instrument* UNCTAD/SDTE/TLB/2003/1. 13, January 2003.
8. Nederveen A., Konings J., Stoop J., *Transport Innovation: An inventory of future development in transportation*, University of Technology Press, Delft, January 1999.
9. Petroski H., *The evolution of useful things*, Knopf Press, New-York 1992
10. Semenov I. N., *Innovative development models of port services*, Polish Academy Sciences, Marine Technology Transactions, Vol.14, 2003.
11. Semenov I. N., *Kierunki strategiczne podwyższenia konkurencyjności polskich portów na tle wymogów UE*, III Konferencja Naukowa: Porty Morskie, Szczecin 2003
12. *Toward a National Intermodal Transportation System.* Final Report (NCIT), September, 1994 Washington D.C.

Wpłynęło do redakcji w grudniu 2005 r.

Recenzent
dr hab. inż. Władysław Buchholz, prof. PS

Adres Autora
prof. dr hab. inż. Iouri Semenov
Politechnika Szczecińska
Wydział Techniki Morskiej
Katedra Logistyki i Ekonomiki Transportu
al. Piastów 41, p. 307
71-065 Szczecin,
tel. (91) 449-47-50
e-mail: jusiem@shiptech.tuniv.szczecin.pl